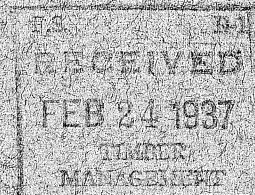


UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

FOREST INSECT INVESTIGATIONS

STUDY OF A MOUNTAIN PINE BEETLE  
INFESTATION IN LODGEPOLE PINE



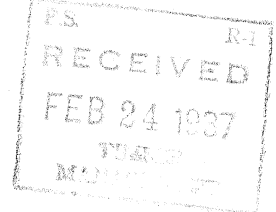
By  
A. L. Gibson  
Assistant Entomologist

Forest Insect Laboratory  
Coeur d'Alene, Idaho  
February 19, 1937

UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE  
WASHINGTON, D.C.

Refer to file  
Project B-5A

Forest Insect Laboratory  
Coeur d'Alene, Idaho  
Feb. 20, 1937



Regional Forester  
Forest Service  
Missoula, Montana

Attention: Mr. Koch

Dear Sir:

There is enclosed copy of a report by Mr. A.L. Gibson entitled "Study of a Mountain Pine Beetle Infestation in Lodgepole Pine". This report depicts the status of the infestation on the Beaverhead National Forest, as well as the results of permanent sample strips on the Targhee and Gallatin Forests.

Very truly yours,

James C. Evenden  
Entomologist

Enclosure

cc to Forest Supervisor, Bhd NF

# STUDY OF A MOUNTAIN PINE BEETLE INFESTATION IN LODGEPOLE PINE

## Introduction

This report is a continuation of the "Report of the Surveys of the Mountain Pine Beetle Infestation on the Beaverhead National Forest". The title has been changed because the infestation has decreased in amount and importance, while other phases have assumed greater importance.

Survey of the mountain pine beetle infestation on the Beaverhead National Forest was confined to the units in the eastern part of the main forest in 1936. Estimates of the infestation in the Big Hole Basin were determined from the Battlefield check strip. No survey was made of the Sheep Canyon Hills south of Dillon or of the remainder of the Beaverhead Forest. Progress of the infestations on the Gallatin Forest was studied by means of a check strip on the Gallatin River drainage, and on the Targhee by means of a similar strip on the Big Bend Ridge near Ashton, Idaho. The general development of the infestation is shown in the tables included in this report.

## The Present Status of the Beaverhead Infestation

Subsequent to the decided reduction in the infestation in 1933, a slight increase occurred in the areas outside of the Big Hole Basin in 1934, to be followed by another winter in which severe mortality occurred, resulting in a decided decrease in the number of attacked

trees. In 1936, following a third winter since 1932 in which excessive mortality occurred, the infestation was still further reduced until now it is less than 20 percent of what it was in 1928. Although at a very low ebb, the outbreak is still a threat to the units on the eastern part of the forest, as they contain much timber of merchantable size which is susceptible to bark-beetle attack. Unless the infestation has been so greatly reduced that other factors will maintain control, it is thought that only a few years of favorable conditions would be necessary to again raise the infestation to where it would cause serious losses.

The status of the general infestation for the period of the survey is as follows:



Table I  
CHANGES IN MOUNTAIN PINE BEETLE INFESTATION  
BEAVERHEAD NATIONAL FOREST

Number of Attacked Trees in										
1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	
67,691 *	722,504	3,119,542	4,898,326	15,402,520	17,586,171	869,647	1,282,510	255,632	147,725	
Increase:	654,813	2,397,038	1,778,784	10,504,194	2,183,651		412,863			
Decrease:						16,716,524		1,026,878	107,907	

\* Estimate considered to have been too conservative; also 55,045 of these trees were treated in 1928. All data subsequent to 1927 corrected for effect of difference in date of survey on total infestation.

From the data in Table I we learn that the outbreak began its general decrease in 1933 as a result of excessive mortality of the overwintering brood. However, decreases which occurred in some units even prior to 1933 are not shown, and for that purpose the change in status on each unit is given in Table II.

Only the total of attacked trees is shown for the period from 1927 to 1930 and annual losses subsequent to that time.

The only portion of the forest for which survey data for 1936 are given is the Melrose, Upper and Lower Wise River, Grasshopper, and Rattlesnake Units. No infestation is believed to be present on any other area with the possible exception of a small amount on the eastern edge of the Warm Springs Unit.

Table II  
SUMMARY SHEET - BEAVERHEAD FOREST SURVEY - 1936  
COMPARISON OF INFESTATION FROM 1927-1936 CAUSED BY THE MOUNTAIN PINE BEETLE IN LOGCROPLE FINE

Unit	Acreage	1927-30	1931	1932	1933	1934	1935	1936
Pintlar	61,600:	1,050,379:	762,485:	667,732:	37,167:	10,651:	None	None
Kussigbrod	56,300:	1,150,910:	1,336,675:	1,424,904:	12,085:	7,848:	None	None
Battlefield	102,400:	2,514,804:	4,445,696:	2,471,203:	37,895:	8,179:	None	None
West Side	76,500:	963,165:	2,031,534:	1,468,693:	52,129:	25,574:	None	None
Jackson	75,800:	976,351:	1,404,498:	1,730,767:	51,279:	16,191:	None	None
Bloody Hook	108,160:	569,470:	1,551,339:	2,796,036:	55,603:	34,744:	Not over: 15,000:	No data
Horse Prairie	57,000:	248,653:	167,124:	93,525:	32,092:	33,425:	Not over: 9,000:	No data
Rattlesnake	68,400:	29,431:	117,990:	513,334:	63,915:	220,487:	63,270:	23,334
Greshamper	42,500:	18,646:	91,587:	574,034:	12,455:	52,395:	18,870:	10,115
Warm Springs	54,500:	245,376:	1,135,856:	1,736,678:	42,241:	63,310:	Not over: 11,500:	5,835
East Side	86,200:	824,789:	1,519,783:	660,867:	13,403:	13,298:	None	None
Upper Wise River	142,800:	60,578:	408,694:	1,166,162:	150,316:	243,945:	24,990:	49,694
Lower Wise River	59,000:	106,746:	231,068:	893,323:	133,578:	134,856:	10,325:	7,198
Melrose	132,700:	10,368:	134,847:	1,182,491:	110,919:	391,757:	25,677:	51,549
Line	218,000:	27,751:	63,344:	206,422:	64,570:	25,850:	Not over: 7,000:	No data
Totals	1,341,860:	8,795,417:	15,402,326:	17,586,171:	869,647:	1,282,510:	355,612:	147,725

(1) No survey data available, but general conditions and trend same as in Big Hole Basin.

Status of the Infestation  
on Each Unit

No mountain pine beetle infestation is thought to exist on the portion of the Beaverhead Forest bordering the Big Hole Basin or the units to the south. Only the eastern portion of the main forest, including the Upper and Lower Wise River Units, Melrose, Rattlesnake, Grasshopper, and the eastern part of the Warm Springs Unit, now support any infestation. There is still considerable mature timber on these units capable of supporting an infestation for a number of years. However, the heavy mortality which has occurred since 1932-33 may have reduced the infestation to the point where other natural control factors may prevent the building up of the infestation.

In order to show the loss per acre and the percentage change in status of the infestation on the different units, Table III has been prepared. The figures given are only for attacks of the mountain pine beetle.



COMPARISON OF ATTACKED TREES PER ACRE AND PERCENT OF INCREASE EACH YEAR FOR PERIOD 1927-1936  
BEAUTEHEAD FOREST SURVEY OF MOUNTAIN PINE BEETLE IN LONGPULP PINE - 1936

Unit	1927-1931	1932	1933	1934	1935	1936			
	Total att. : trees per acre	Att. : trees per acre	% Change : over trees per acre	Att. : trees per acre	% Change : over trees per acre	Att. : trees per acre	% Change : over trees per acre	Total trees : killed per acre	% Change : over trees per acre
Pintlar	29.78	10.08	-18.5	.60	-94.0	.17	-71.3	-	40.64
Mussigbrod	44.57	25.32	6.7	.22	-99.2	.14	-35.1	-	70.25
Battlefield	68.02	24.13	44.4	.37	-98.5	.08	-78.4	-	92.60
West Side	49.15	19.21	-27.7	.68	-96.5	.33	-50.9	-	59.37
Jackson	31.47	22.84	23.3	.68	-97.0	.21	-68.4	-	55.19
Bloody Dick	19.61	25.85	80.3	.51	-98.0	.32	-37.5	-	46.44
Horse Prairie	7.29	1.64	44.0	.56	-65.7	.59	4.1	-	10.25
Battlesnake	2.15	7.50	335.3	.93	-87.6	3.22	245.0	-	15.14
Grassborner	2.58	13.52	527.4	.34	-97.5	1.23	320.7	-	18.35
Warm Springs	25.35	31.88	52.9	.78	-97.6	1.16	49.9	-	59.77
East Side	27.38	7.67	-56.6	.06	-99.2	.15	-	-	35.26
Upper Wise River	3.28	8.17	185.3	1.05	-87.1	1.71	62.3	-	14.73
Lower Wise River	5.73	15.13	286.5	2.26	-85.0	2.29	1.0	-	25.70
Melrose	1.10	8.91	776.4	.84	-90.6	2.95	253.2	-	14.92
Line	.42	.95	225.4	.30	-68.7	.12	-60.0	-	1.81
Totals & Averages	18.08	13.11	14.2	.65	-95.1	.96	78.3	-	33.04

Of the trees attacked on the units surveyed in 1936 only slightly over two-thirds (68%) were killed, 23.9 percent were "pitched-out", and 8.1 percent were green-sided. It can be readily seen from the above figures that high mortality must occur when the insects are attacking in comparatively small numbers. Trees in which they were "pitched-out" represent almost certainly 100 percent mortality of the attacking insects, and even those trees that are green-sided will probably show considerable mortality among the insects that have attacked the borders of the infested areas.

#### Infestation on Other Parts of the Beaverhead Forest

No data are available for the Sheep Canyon Hills, the Blacktail Creek drainage, or the Tobacco Root Mountain regions, but it is believed that the same factors which have reduced the infestation on the main part of the forest have been operative there. These areas differ slightly, however, in that whitebark and limber pine at high elevations comprise a larger percentage of the total stand. In these hosts a larger proportion of the mountain pine beetle brood may have survived because of thicker bark and different site conditions than in the lodgepole pine stands. Reduction of the infestation in these areas since 1932 may have been somewhat less because of the above-mentioned factors.

Secondary bark beetles, chiefly Pityogenes knechteli, but also Pityophthorus burkei, Ips radiatae, and Ips oregoni, have been causing an increasing proportion of the losses since 1933. While the infestation

was increasing, the portion of the trees which the mountain pine beetle had not attacked was the preferred and sufficient host material for the normal increase in secondary insects. Following the serious reduction in the numbers of the mountain pine beetle in 1933, apparently without a similar reduction of the secondary insects, the "ready-made" host material was insufficient for the latter insects, and a large proportion of them were forced into green trees which are an unfavorable host. The data for the four years showing losses due to secondary insects and the proportion they were of the total attacked each year are as follows:

Table IV  
LOSSES DUE TO SECONDARY INSECTS ON THE BEAVERHEAD  
FOREST - 1933-1936

	: 1933	: 1934	: 1935	: 1936
Number of trees	:	:	:	:
attacked by secondary:	:	:	:	:
bark beetles	: 988,558	: 7,383,098	: 4,395,093	: 1,637,000
Percent secondary	:	:	:	:
losses are of total	:	:	:	:
losses for year	: 53	: 85	: 24.5	: 21.7

Losses from secondary bark beetles seem to be heaviest where a declining mountain pine beetle infestation is present. Under such conditions the normal increase in secondary insects together with a decreasing supply of suitable host material forces a large proportion of the secondary brood into green trees in their effort to continue the life cycle. The insects attacking the green trees probably suffer a high mortality. Where no mountain pine beetle infestation is present

to act as a source of supply, the secondary insects seem unable to maintain their numbers and in a few years are causing only negligible losses.

In the Big Hole Basin and on areas to the south where infestation conditions are quite similar, the data from the Battlefield check strip indicate previously attacked but still living trees, as well as unattacked trees, totalling .75 per acre, were attacked in 1936 by secondary insects. The total killed in this drainage amounted then to about 500,000 trees. In the eastern part of the forest, where the mountain pine beetle is still present, the loss from secondaries amounted to 2.47 trees per acre, or about 1,137,000 trees. While the total loss from these bark beetles in 1936 and other years seems high, it may be well to point out that much of their activity has been in weakened or defective trees which would never grow to merchantable size and whose removal from the stand is usually a benefit in that stand competition from them is eliminated. In addition we find that the green trees attacked by these secondaries are usually of small diameter, and even though healthy they are often part of an overstocked stand from which their removal is beneficial. Peridermium, porcupines, mistletoe, snowbreak, and windbreak often weaken a tree, and it serves as an attractant to the insects.

#### The Battlefield Check Strip

Now that bark-beetle activity has practically ceased in the Big



Hole Basin it may be well to consider what remains. It must be remembered, however, that conditions in the Big Hole Basin may not be representative, as a number of factors may have influenced the trend of the infestation. In the first place, the Big Hole Basin was the junction point of two large infestations or of two parts of what may have been the same infestation. One swept <sup>east</sup> ~~west~~ from Idaho and the other south and southwest from the Bitterroot. Just what effect this concentration of bark beetles had we do not know. Possibly more serious losses resulted than would have occurred under ordinary conditions, but up to the present time we have no data from an area where the infestation was not affected by such an occurrence with which to compare it. The second factor was the abrupt reduction of the infestation in 1932-33. Mountain pine beetle activity was reduced about 95 percent, a much greater reduction than would have occurred had this factor not intervened. Activity of secondary bark beetles caused considerable loss in 1933 and heavy losses in 1934 and 1935, probably much higher than would have occurred from that source had the reduction been less abrupt. They have continued as the major destroying agency since that time, concentrating largely upon the previously insect-damaged and otherwise weakened trees, but also killing many of the smaller green ones.

In considering the losses which have occurred we find slightly over one-fourth (26.9%) of the total trees one inch or over in diameter have been killed or injured. Numerically, while this loss is considerable,

its real significance is not apparent because the remaining trees are of the smaller diameter classes which are almost immune to bark-beetle attack. If the basal areas of the killed and surviving trees are compared, a better index of losses is secured. On that basis we find that over half the basal area has been killed (50.9%), and an additional 15.4% damaged, leaving only one-third of the original basal area of lodgepole pine and the small percentage of other tree species unattacked by bark beetles. Compared on this basis we find that losses have been serious in that they have involved practically the entire merchantable volume.

The preinfestation forest contained many different age classes. With the destruction of all trees over 11 inches in diameter, the older age classes have been eliminated and only the younger trees remain. The detailed data for the remaining stand in each even-inch class are given in Table V, as well as a summary of the basal area status which is given to facilitate comparison of the two methods of computing. In Table VI the types of losses are given for the total area and per acre.

Not only has the average diameter and age of the lodgepole pine been greatly decreased, but an increase in the proportion of other tree species to the total surviving automatically occurs with the removal of so much of the stand susceptible to bark-beetle attack. Prior to the infestation these other species made up 2.9 percent of the total basal area of the stand. Now they comprise 5.8 percent of the basal

area, and with the more open stand conditions they, and reproduction from them, are in a position to compete more successfully with the surviving and oncoming lodgepole pine. The eventual conversion of the stand type from pure lodgepole pine to the climax type of mixed species has been given considerable impetus by the infestation, even though the amount of other species is still quite small. However, it remains to be seen if human agencies can prevent fires from sweeping these areas where the infestation has so materially increased the fire hazard.

Table V

STATUS OF LODGEPOLE PINE ON THE BATTLEFIELD CHECK STRIP SUBSEQUENT TO THE MOUNTAIN PINE  
BEETLE INFESTATION - DATA ARE FOR NUMBER OF TREES AND FOR PERIOD UP TO OCTOBER 1936

																	% ori-
																	% ori-
DBH																	Sq. ft. : ginal : Aver-
Classes	2	4	6	8	10	12	14	16	18	20	22	Total	stand	area	area	DBH	age
LP per acre																	
prior to in-																	
festation	547.94	274.33	179.08	123.06	52.03	17.05	9.50	1.06	.81	-	.03	1,204.59	97.2	168.89	97.1	4.27	
At end of '36:																	
Green	538.07	243.87	74.83	19.18	4.72	-	-	-	-	-	-	880.67	71.1	56.98	32.7	3.07	
Pitched-out &																	
green-sided	.02	-	35.22	46.06	5.41	-	-	-	-	-	-	86.71	7.0	25.94	14.9	7.31	
Other species:	18.25	7.23	3.36	2.67	1.37	.28	.25	-	-	.28	.25	33.94	2.7	5.12	2.9	4.08	
Grand total																	
living trees																	
per acre	556.34	251.10	113.41	67.91	11.50	.28	.25	-	-	.28	.25	1,001.32	80.8	88.04	50.5	3.46	



Table VI  
TREES ATTACKED ON THE BATTLEFIELD CHECK STRIP BY BARK BEETLES  
DATA UP TO AND INCLUDING 1936

Area = 36 Acres		
	<u>Total</u>	<u>Per Acre</u>
Killed by <u>D.m.</u>	6,110	169.7
Killed by <u>D.m.</u> & <u>Ips</u> sp.	835	23.2
Killed by <u>Ips</u> sp.	<u>1,606</u>	<u>44.6</u>
Total	8,551	237.5
Trees with green side following <u>D.m.</u> attack	577	16.0
Trees which have "pitched-out" <u>D.m.</u> attacks	2,527	70.2
Trees which have "pitched-out" <u>Ips</u> sp. attacks	<u>18</u>	<u>.5</u>
Total	<u>3,122</u>	<u>86.7</u>
Grand Total	<u>11,673</u>	<u>324.2</u>

#### The Wise River Check Strip

During 1936 bark-beetle activity on the Wise River check strip was very light. Secondary bark beetles filled-in 10 previously attacked trees and attacked 41 green trees, 36 of which they killed. All of the 41 were comparatively small, 33 being less than 5 inches in diameter. The mountain pine beetle attacked 13 trees and killed 9 of these. The mountain pine beetle infestation on this area is at a low ebb at the present time as a result of severe mortality annually since 1932, except for a slight increase in 1934.

Total stand losses due to bark-beetle activity have been lighter in this area than in the Big Hole Basin. The infestation was just beginning to be severe when the decided reduction of 1932-33 occurred, which was followed by a decided decrease in mountain pine beetle activity. Subsequent reductions have kept the infestation at a low level. A second factor which may have helped reduce the losses on the Wise River strip has been the large percentage of other timber species in the stand. There is a possibility that bark beetles are not as effective in a mixed stand as in a practically pure stand of lodgepole pine, of which the Battlefield strip is typical. If destruction on the latter strip may be considered as an index, there is still considerable timber on the Wise River strip susceptible to mountain pine beetle attack. However, before any definite conclusions can be drawn, it must be remembered that the infestation is still present in this area.

At the time this infestation began Douglas fir and other tree species unsusceptible to mountain pine beetle attack comprised 25.6 percent of the number of trees in the stand and 33.7 percent of the basal area. Since then the stand of lodgepole has been greatly depleted, and as the larger trees have been the ones killed, the basal area loss has been proportionately much larger. Now Douglas fir and other species comprise 28.0 percent of the number of trees and 46.1 percent of the basal area. One-half the living trees seven inches and over now are of tree species unsusceptible to bark-beetle

attack, where prior to the infestation they comprised less than one-third of the total.

The present status of the Wise River check strip is shown in Tables VII and VIII.

Table VI  
STATES OF THE ARIZONA RIVER BASIN  
1961 - 1966

Classes	2	4	6	8	10	12	14	16	18	20	22	24	26	Total	stand	area	%	Original	%	Original	Average
IP per acre																					
prior to in-																					
festation	213.2	176.4	55.4	46.8	14.6	10.5	5.1	8.7						523.0	74.4	70.9	65.3				4.2
At end of '36																					
Green	207.9	172.0	46.2	28.2	3.6	9	9	1.1						459.9	65.4	42.3	39.1				3.6
Pitched-out &																					
Green-sided			2.1	6	1.4	4	4	1.02						2.9	4	1.4	1.2				8.2
Other species	70.8	50.7	24.9	9.8	6.4	8.1	4.6	3.3	7.4					2180.1	25.6	37.4	34.7				4.9
Grand total																					
living trees																					
per acre	278.7	222.8	71.7	32.4	10.4	9.4	5.5	3.4	8.4					2642.9	91.4	81.1	75.1				4.0



Table VIII  
TREES ATTACKED ON THE WISE RIVER CHECK STRIP BY BARK BEETLES  
DATA UP TO AND INCLUDING 1936

	<u>Total</u>	<u>Per Acre</u>
Killed by <u>D.m.</u>	1,577	39.4
Killed by <u>D.m.</u> & <u>Ips</u> sp.	277	6.9
Killed by <u>Ips</u> sp.	<u>537</u>	<u>13.4</u>
Total	2,391	59.7
Trees with green side following <u>D.m.</u> attack	4	.1
Trees which have "pitched-out" <u>D.m.</u> attacks	137	3.4
Trees which have "pitched-out" <u>Ips</u> sp. attacks	<u>6</u>	<u>.2</u>
Total	147	3.7
Grand Total	2,538	63.4

#### The Elkhorn Check Strip

This strip showed the greatest losses during 1936 from both the mountain pine beetle and secondary bark beetles. However, few trees were killed by the primary insect, but the secondaries killed 121 trees, "filled-in" 13 which the mountain pine beetle had failed to kill, and unsuccessfully attacked 6 more. Trees which secondaries alone were responsible for the killing of were chiefly of the smaller diameter classes. On the Wise River and Elkhorn strips, although secondaries had killed 85.5 percent of the total trees infested in 1936, the basal area they destroyed was only 66.5 percent of the total.

Usually too, they attacked groups of trees one or more of which had been weakened or damaged and thus attracted the beetles. The chief agencies which weaken the trees are porcupines, peridermium, mistletoe, snowbreak, and windbreak.

The small percentage of timber species unsusceptible to mountain pine beetle attack in this stand is unlikely to exert any appreciable influence on either the degree of attack of susceptible species or on future stand composition.

The status of the stand at the present time on the Elkhorn strip is given in Tables IX and X.

Table IX  
STATUS OF THE STAND ON THE ELKHORN CHECK STRIP - MOUNTAIN PINE BEETLE IN LOGS OF THE  
SEAVIEWEAD NATIONAL FOREST - 1936

[illegible]

Table X  
TREES ATTACKED BY BARK BEETLES ON THE ELKHORN CHECK  
STRIP UP TO AND INCLUDING 1936

	<u>Total</u>	<u>Per Acre</u>
Killed by <u>D.m.</u>	707	19.6
Killed by <u>D.m.</u> & <u>Ips</u> sp.	142	3.9
Killed by <u>Ips</u> sp.	<u>1,102</u>	<u>30.6</u>
Total	1,951	54.1
Trees with green side following <u>D.m.</u> attack	23	.6
Trees which have "pitched-out" <u>D.m.</u> attack	76	2.1
Trees which have "pitched-out" <u>Ips</u> sp. attack	<u>79</u>	<u>2.2</u>
Total	178	4.9
Grand Total	<u>2,129</u>	<u>59.0</u>

The Infestation on the Gallatin  
National Forest

In order to gain some idea of the development of the mountain pine beetle infestation on the Gallatin National Forest a check strip five miles long and one chain wide was examined on the Squaw Creek drainage of the Gallatin Forest. This strip embraces the major types of timber to be found on the Gallatin and represents many different site conditions. In the lodgepole pine stands only one "pitched-out" mountain pine beetle-attacked tree for 1936 was noted. In the white-bark pine 18 trees were killed in 1936, one was "pitched-out", and two green-sided. In 1935 only 10 were killed, showing a slight increase

had occurred in 1936. Up to but not including 1935, 21 lodgepole pine had been killed and 3 in 1935. Up to but not including 1935, 64 whitebark pine had been killed by the mountain pine beetle. Secondaries had killed only one tree, an eight-inch lodgepole pine.

Basal area losses have been heavy due to the large size of the attacked trees. In lodgepole pine the killed and attacked trees up to the present time totalled 53.35 square feet, in whitebark pine 146.09 square feet. From the preceding data it can be concluded that no appreciable infestation of the mountain pine beetle is as yet present in the lodgepole pine on this strip. In whitebark pine an active infestation is present, but it has not reached serious proportions.

An active infestation in lodgepole pine was known to be present on the northwest corner of the Gallatin Forest in 1935. No data concerning it were secured in 1936, but it is believed the same factor which caused severe mortality on the Beaverhead in the winter of 1935-36 prevented any increase on the Gallatin Forest.

The Infestation on the Targhee National  
Forest as Indicated by the  
Ashton Check Strip

This strip, which has been examined for the three years 1934, 1935, and 1936, showed for its 40 acres an average of 9.975 trees per acre attacked in 1934, 11.975 per acre in 1935, and 6.300 in 1936. If this strip may be considered representative of conditions over the forest as a whole, a decided reduction in infestation (47.4 percent) occurred in 1936. The reason for this reduction is not apparent, as

there were no unusual weather conditions known to have occurred during the winter of 1935-36 near the check strip. It is possible, however, that the check strip may not be representative of actual conditions, that unusual weather conditions may have developed in the timber which were not present at the nearest weather recording station, or that some unapparent control factor may have developed.

In addition to a decline in amount, the character of the infestation has changed as may be seen by comparing the percentage in each class for each year as given in the following tabulation.

Table XI  
COMPARISON OF BARK BEETLE ATTACKS ON  
ASHTON CHECK STRIP IN 1935 AND 1936

Year	: Total : trees : attacked	: Percent : killed by : Ips sp.	: Percent : killed : by D.m.	: Percent green-sided : and pitched-out from : D.m. attack
1935	479	1.0	50.1	48.9
1936	252	30.6	22.6	46.8

The preceding tabulation indicates quite clearly the decrease in total activity by bark beetles in 1936 on the strip, the more important role that secondary insects played in destruction for that year, and the decidedly smaller proportion killed by the mountain pine beetle. From the data we can conclude that the infestation is not as aggressive as in 1935.

#### Summary

The outstanding findings of the 1936 study were as follows:

1. Losses in the Big Hole Basin region continue to be light.

limited to secondary bark beetle activity, and confined largely to weakened trees.

2. Losses on the eastern units of the main Beaverhead have declined to where they are less than 20 percent of what they were in 1928.

3. Secondary bark beetles continue to cause over 90 percent of the bark beetle losses on the main portion of the Beaverhead Forest, although the total has materially decreased.

4. No active infestation of the mountain pine beetle in lodgepole pine was noted on the check strip on the Gallatin Forest. In the white-bark pine, however, there is a slightly increasing infestation which has been present for a number of years.

5. The infestation on the Ashton check strip on the Targhee Forest showed a decided decrease in 1936, which is probably indicative of a decrease over the entire forest.